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Johnson

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(54) **REMEDIATION PACKER**

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CPC ***E21B 33/12*** (2013.01)

(58) **Field of Classification Search**
CPC B09B 1/006; E21B 21/00; E21B 41/005
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,041,863 A * 3/2000 Lindsey B09C 1/002 166/187

* cited by examiner

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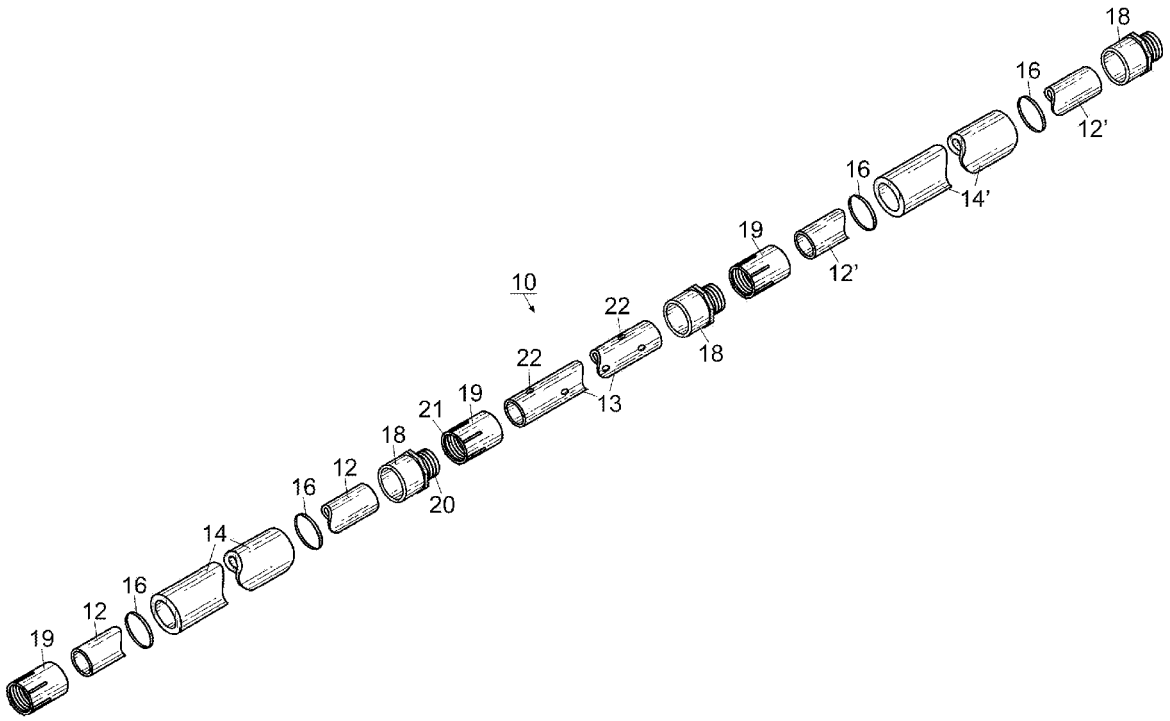
(57) **ABSTRACT**

A remediation packer assembly including an inlet pipe defining a plurality of radially-oriented inlets and attached at opposing ends to stinger pipes with wrap sleeves positioned thereon. The assembly may be inserted into a monitoring pipe and inserted into a substrate, for example a well, for the collection of free product in a fluid or unsaturated environment. For example, the remediation assembly is inserted into the well until the collection zone as defined by the wrap sleeves is in planar orientation with the free product, and in the case of vacuum remediation, the free product is removed from the fluid column and brought to the surface where it may be processed and removed. A method of remediating the substrate is also provided.

19 Claims, 4 Drawing Sheets



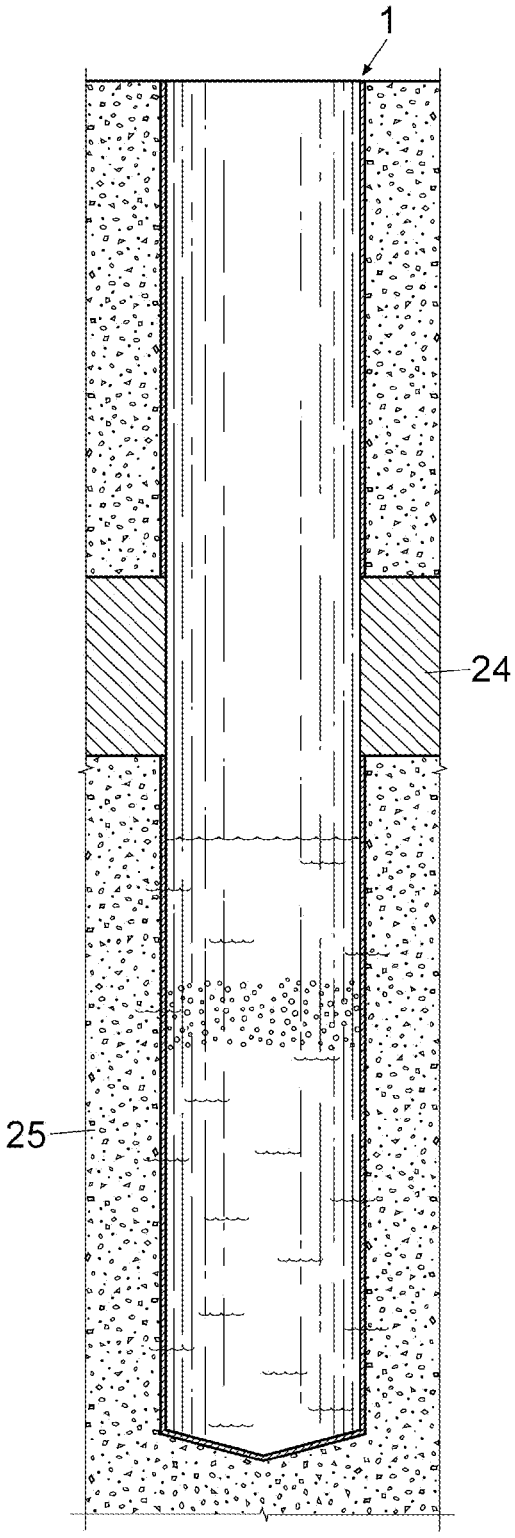


Fig. 1

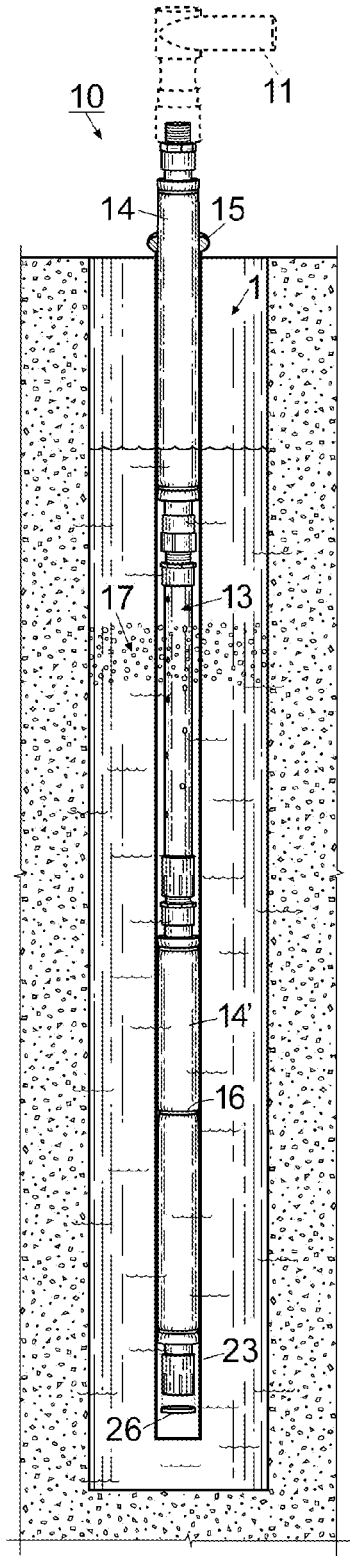


Fig. 2

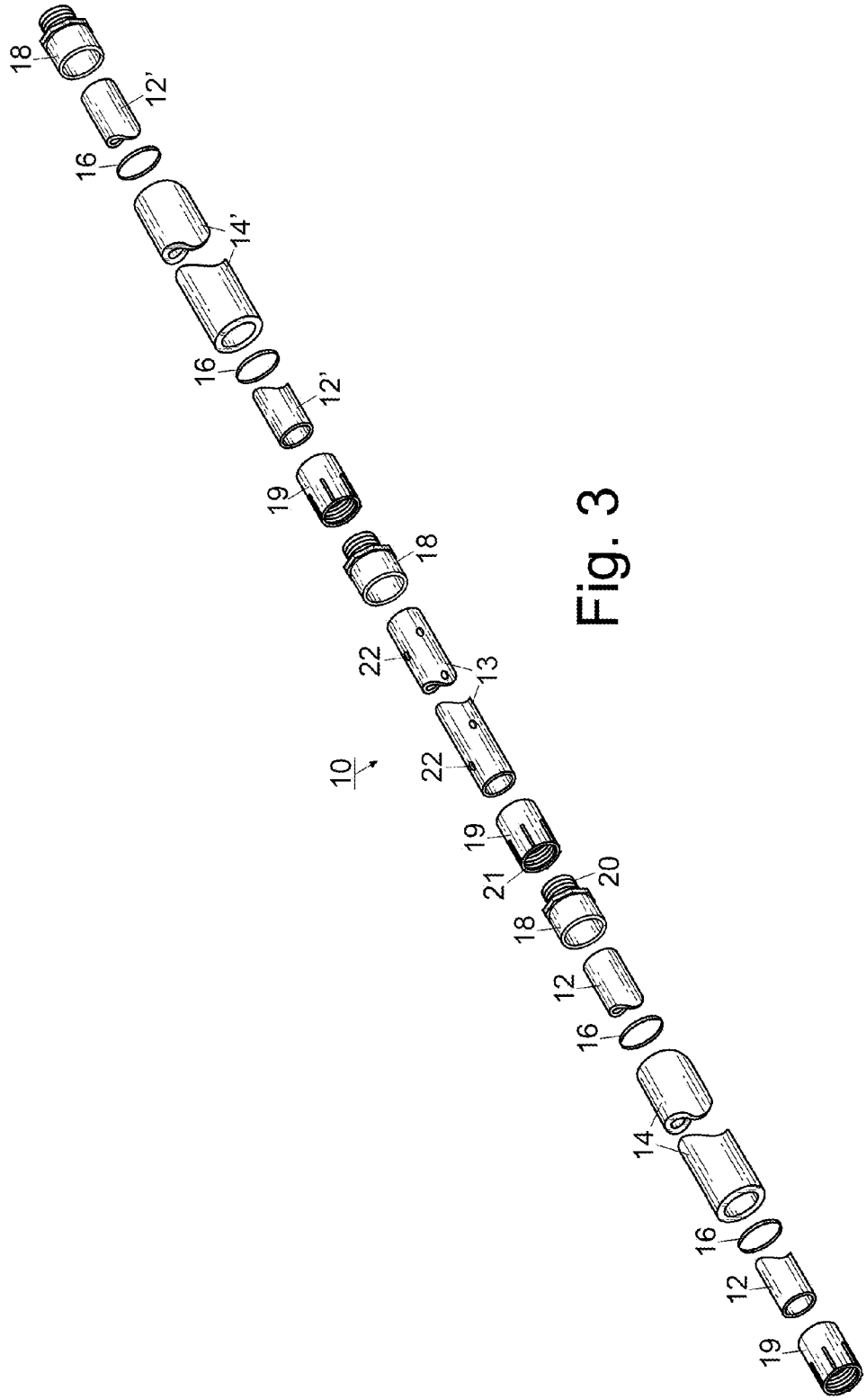


Fig. 3

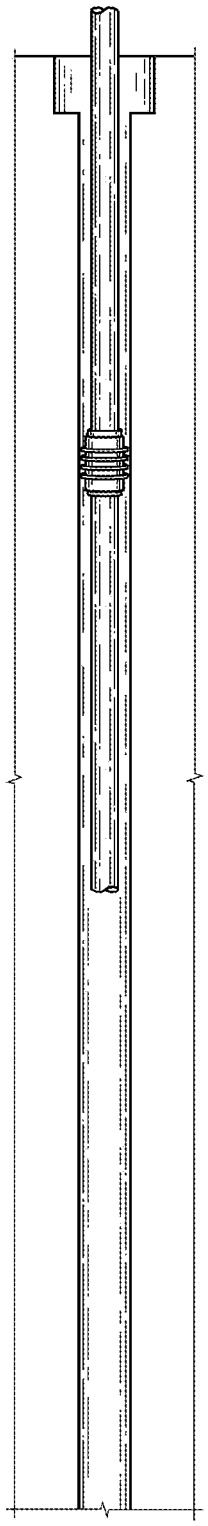


Fig. 4
Prior Art

REMEDIATION PACKER

FIELD OF THE INVENTION

The invention herein pertains to well and other bore-hole packers and particularly pertains to remediation assemblies for radial removal and internal specific recovery of free product and other phase contaminants from monitoring wells, extraction wells, and other fluid-containing environments.

DESCRIPTION OF THE PRIOR ART AND OBJECTIVES OF THE INVENTION

Ground environmental remediation efforts typically focus on the removal of contaminants and pollutants from the groundwater, soil, sediment, surface water, and the like. Other times, fluids such as air or water may be introduced or injected back into a subterranean cavity. Often, ground remediation is focused to a well or similar environment, wherein the remediation of the well is for the general protection of human health and environmental protection or rehabilitation. Remediation efforts are increasingly subjected to an array of governmental and industrial regulatory requirements, such as EPA Regulations 40 CFR 280, 281, and 282 which are incorporated by reference herein in its entirety. In a conventional well environment (as shown in FIG. **1**), a hole is drilled to a predetermined depth and a casing is positioned within the well bore. The casing may be formed from PVC or metal and is positioned in the well bore as is known in the art. In monitor or extraction well applications, a passageway may be defined through the casing and into the strata, thereby allowing fluids such as water, hydrocarbons or the like to flow into the casing through openings, perforations, or other apertures formed therein. This casing may be referred to as a monitoring well (see FIG. **1**). In most cases, impermeable inserts such as a bentonite layer and permeable inserts such as a sand filter pack may be positioned around the casing for well structural support as well as an attempt to block large particulates from accessing the well.

Remediation of a well is often difficult and demanding work. Remediation methods include vacuum, air sparging, and injection remediation and each may utilize vacuum or other pumps in the pumping and treatment of contaminated groundwater. Typically, the extracted groundwater is purified via mechanical and biological methods which may remove and/or absorb undesirable contaminants in the groundwater. However, conventional vacuum pump and treatment systems are often inefficient, costly, labor-intensive and timely endeavors. For instance, it is not uncommon to remediate a water well with petroleum products, and in particular to attempt to filter the petroleum free product in an effort to purify the groundwater using traditional systems and methods. Therefore, packers have been used to assist in the collection, removal, addition, or filtration of fluids such as water, air, and the like. Typically, a temporary packer is delivered down a well via an elaborate conveyance and expansion system. However, even with the aid of these demanding conveyance and expansion packer systems, conventional pumps and treatment of well environments is a difficult and expensive process. Alternatively, permanent packers may be inserted into the well that use ribs or other frictional engagement means to seal the well and allow vacuum. These devices are expensive and cannot be recovered from the site once the remediation is complete.

It is often very difficult to ascertain the level of contamination in a given column of fluid, which may lead to repositioning the packer several times before the correct level is determined. Remediation is conventionally accomplished by pulling fluid through a terminal end of a recovery pipe (sometimes referred to as a "stinger" pipe) which may include a filtering device, screen, or the like. This leads to a cone of depression resulting in over-inclusive and inefficient fluid removal, short-circuiting, and filtration, further leading to increased time and cost of a given remediation project.

Thus, in view of the problems and disadvantages associated with prior art devices, the present invention was conceived and one of its objectives is to provide a remediation assembly for radially removing free product or other contaminants from a specific interval in a well or fluid column.

It is another objective of the present invention to provide an adjustable remediation assembly including a pipe with a plurality of inlet draws with a pair of wrap sleeves opposingly positioned above and below the radial collection zone.

It is still another objective of the present invention to provide a remediation assembly with a plurality of adjustable clamps for securing the sleeves to the pipe.

It is yet another objective of the present invention to provide a remediation assembly with an internal monitoring pipe screen, sleeves with an inlet screen to recover the fluid under vacuum.

It is a further objective of the present invention to provide a multi-use remediation assembly capable of vacuum, air sparging, and injection remediation.

It is still a further objective of the present invention to provide a remediation assembly configured to radially collect petroleum product or vapors in planar orientation to the collection zone, the collection zone adjustably defined via the packer sleeves and adjustable clamps.

It is yet a further objective of the present invention to provide a remediation assembly in fluid communication with a vacuum system, pump system, or a fluid-introduction system.

It is a further objective of the present invention to provide a remediation assembly that can conduct a remediation operation and thereafter be removed from the project location without substantial time, expense, and expertise.

It is another objective of the present invention to provide a remediation packer that is inexpensive to manufacturer and simple to use such that it can be disposed after a single use.

It is still a further objective of the present invention to provide a method of utilizing a radially collecting vacuum remediation packer with easily adjustable expansion zones that define a collection zone to capture contaminants and free product from a well or other fluid environment.

Various other objectives and advantages of the present invention will become apparent to those skilled in the art as a more detailed description is set forth below.

SUMMARY OF THE INVENTION

The aforesaid and other objectives are realized by providing a remediation packer assembly configured for use during vacuum remediation, injection remediation, and sparging remediation. The assembly includes an inlet pipe defining a plurality of radially-oriented inlets and is attached at opposing ends via male and female couplers to stinger pipes with petroleum-resistant wrap sleeves positioned thereon. Two or more adjustable clamps are used to affix the wrap sleeves to their respective stinger pipes, and the wrap sleeves in combination with the inlets define a radial collection zone for pulling fluids out of the remediated site for

processing and disposal, for example water, petroleum, noxious vapor, or the like. The assembly may be inserted into a monitoring pipe and inserted into a substrate, for example a water well, for the collection of free product in a fluid environment. The remediation assembly is inserted into the well until the collection zone as defined by the wrap sleeves and inlets is in planar orientation with the free product or area of concern, and in the case of vacuum remediation, the free product is removed from the fluid column and brought to the surface where it may be processed and removed. A method of remediating the substrate is also provided.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** demonstrates an elevated side view of a conventional monitoring well;

FIG. **2** shows an elevated side view of a remediation packer in communication with an optional vacuum system in the well of FIG. **1**, the opposing side being a mirror image thereof;

FIG. **3** pictures an exploded perspective side view of the remediation packer of FIG. **2**; and

FIG. **4** depicts a prior art remediation packer.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT AND OPERATION OF THE INVENTION

For a better understanding of the invention and its operation, turning now to the drawings, FIG. **2** illustrates schematically an elevated side view of remediation packer assembly **10** positioned in a operating environment such as well **1** and in communication with vacuum system **11**, illustrated with dotted lines. As is known in the art, well **1** as also shown in FIG. **1** may be bore into a fluid-containing substrate, forming an aperture to insert packer assembly **10** therein, for example in a water-containing well or the like. In most cases, impermeable inserts such as bentonite layer **24** and permeable inserts such as sand filter pack **25** may be positioned around monitoring well **1** for well structural support as well as an attempt to block large particulates from accessing the well.

Remediation packer assembly **10** includes stinger pipe sections **12**, **12'** which are connected at either end of inlet pipe **13**. At least one of a plurality of wrap sleeves **14**, **14'** are attached to each of stinger pipe sections **12**, **12'** and in opposing relation thereon. Preferred remediation packer assembly **10** includes monitoring well **15**, which is positioned in well **1** for maintaining the structural integrity of well **1** and to receive stinger pipe sections **12**, **12'** and frictionally engages wrap sleeves **14**, **14'** to create a beneficial pressure differential for remediation during operation of vacuum system **11**. Monitoring well **15** may also define annular space between the wall of well **15** and the wall of well **1**. This space may include sand or other porous, filtering material located immediately distal the walls of well **15** which filters out particulates prior to processing by remediation packer assembly **10**. Monitoring well **15** also preferably includes screened interval **23** that permits water and vapor as well as free product to be drawn through inlet pipe **13** and transported to the surface for recovery, processing, and disposal.

FIG. **3** shows a side perspective view of remediation packer assembly **10** with the various components exploded therefrom. Wrap sleeves **14**, **14'** are preferably formed from cylindrical petroleum-resistant polyethylene, nitrile, or neoprene but may be formed from any material that can encase stinger pipe sections **12**, **12'** and frictionally engage monitoring well **15** to provide a beneficial pressure differential during vacuum remediation. Sleeves **14**, **14'** may be longitudinally adjusted along stinger pipe sections **12**, **12'** to define a radial collection zone **17** to focus remediation efforts at an isolated zone of interest proximate screened interval **23**, thereby avoiding unnecessary remediation resources and time. Although two wrap sleeves **14**, **14'** are shown in FIGS. **2** and **3**, a greater number of sleeves **14** may be deployed during remediation packer assembly operation to alter the size and shape of collection zone **17** as dictated by the size, shape, and environment of well **1**. For example, collecting free product at radial collection zone **17** minimizes excessive fluid processing and recovery while reducing the time and cost associated with a specific remediation project. Preferably, wrap sleeves **14**, **14'** define upper and lower expansion zones and are oriented such that collection zone **17** is positioned in a planar orientation to the target fluid containing the free product to be remediated and any escape, short-circuiting or leakage is prevented by the respective expansion zones. Free product-containing fluid is drawn through screened interval **23** and is directed towards inlets **22** by wrap sleeves **14**, **14'**.

One or more wrap sleeves **14**, **14'** may be adjustably affixed to different ones of stinger pipe sections **12**, **12'** with a variety of fasteners, zip ties, adhesives, and the like, but are preferably attached with a plurality of metallic, screw-driven circular clamps **16**. Clamps **16** may be longitudinally spaced along the length of wrap sleeves **14**, **14'** before remediation packer assembly **10** is inserted into well **1** for use. By positioning, loosening, or tightening clamps **16** on wrap sleeves **14**, **14'**, a user may adjust the size, shape, and orientation of collection zone **17**, as well as alter the pressure differential as experienced at collection zone **17**. This adjustability affords increased flexibility to remediation packer assembly **10** over prior art devices that have a fixed draw depth and collection zone pressure such as the one shown in FIG. **4**. The size, shape, and orientation of sleeves **14**, **14'** may also be adjusted to ensure that collection zone **17** is in planar orientation with the free product or interval desired to be collected. During operation, planar orientation of collection zone **17** with the level of free product, for example a layer of petroleum free product, significantly reduces the amount of fluid that need be filtered to complete the remediation of a given well, leading to savings in cost and time.

Preferred remediation packer assembly **10** includes a plurality of male couplers **18** and female couplers **19** to attach inlet pipe **13** to stinger pipe sections **12**, **12'**. In one or more embodiments of remediation packer assembly **10**, male couplers **18** and female couplers **19** may also be utilized to connect additional inlet pipes **13** for multiple collection zones **17**, additional stinger pipe sections **12**, **12'** for extending remediation packer assembly **10** into deeper wells, or to vacuum assembly **11** for vacuum remediation. Male couplers **18** and female couplers **19**, along with cap **26** (FIG. **2**) are configured to assist in maintaining a beneficial pressure differential at collection zone **17** by ensuring that no pressure release takes place between the portion of remediation packer assembly **10** proximal the surface and collection zone **17**. While this may be accomplished in a variety of ways, preferred male coupler **18** defines threaded end **20** that is sized to be received within threaded receiver **21**, defined in preferred female coupler **19**. The opposing ends of male coupler **18** and female coupler **19** are sized and shaped to receive the diameter of a pipe therein, for example stinger pipe sections **12**, **12'** or inlet pipe **13**, respectively. In

use, the pipe engages male coupler **18** or female coupler **19**, for example frictionally or with the use of an adhesive. Threaded end **20** is inserted into threaded receiver **21** and rotated until a seal is formed between male coupler **18** and female coupler **19**, preferably tight enough such that no fluid escapes from the joint. This tight engagement may include washers, gaskets, or the like and ensures that no pressure drops during vacuum remediation, no air escapes during sparging remediation, and no chemicals escape during injection remediation, as well as no pollutants are released during well water remediation.

A method of remediating a fluid environment such as a well includes providing remediation packer assembly **10** with inlet pipe **13** which defines a series of radially oriented inlets **22** and is attached at opposing ends to different ones of stinger pipe sections **12**, **12'** via male threaded couplers **18** and female couplers **19**, respectively. A plurality of circular clamps **16** are utilized to secure wrap sleeves **14**, **14'** to different ones of stinger pipe sections **12**, **12'** to ensure the appropriate pressure differential is maintained at collection zone **17** created by vacuum system **11** and inlets **22** and adjustably positioned in planar orientation to the free product to be remediated are also provided. Well **1** is bored out of a fluid-containing substrate, and monitoring pipe **15** is inserted therein, defining annular space between the walls of well **1** and monitoring pipe **15**. The depth of the free product-containing fluid is determined, and the clamps **16** and wrap sleeves **14**, **14'** are oriented to define collection zone **17** in planar orientation to that predetermined depth. Remediation packer assembly **10** is inserted into well **1** within monitoring pipe **15** such that wrap sleeves **14**, **14'** are in tight frictional engagement with monitoring pipe **15** and collection zone **17** is positioned in planar orientation with the fluid to be remediated. Vacuum system **11** is engaged, and the negative pressure within remediation packer assembly **10** draws fluid and free product through inlets **22** and to the surface, where the free product is separated and discarded. In an alternate embodiment of remediation packer assembly **10**, filters may be placed in the annular spaces formed between well **1** and monitoring pipe **15** or in collection zone **17** over inlets **22** to strain particulates such as sediment from the remediated fluid (not shown).

A method of remediating an environment such as a well includes providing a remediation packer assembly with inlet pipe which defines a series of inlets **22** and is attached at opposing ends to different ones of stinger pipe portions **12**, **12'** via male threaded couplers **18** and female couplers **19**, respectively. A plurality of circular clamps **16** to secure wrap sleeves **14**, **14'** to different ones of stinger pipe portions **12**, **12'** to ensure the appropriate pressure differential is maintained is also provided. Well **1** is bored out of a substrate, and monitoring pipe **15** is inserted therein, defining annular space between the walls of well **1** and monitoring pipe **15**. Remediation packer assembly **10** is inserted into well **1** within monitoring pipe **15** such that wrap sleeves **14**, **14'** are in tight frictional engagement with monitoring pipe **15**. Remediation material, for example air sparging or chemicals, are then pumped through stinger pipe sections **14**, **14'** and released through inlets **22** in inlet pipe **13**. The frictional engagement of sleeves **14**, **14'** prevent backflow of the remediation material to the surface, increasing the efficiency of the remediation effort and reducing the time and cost associated therewith.

The illustrations and examples provided herein are for explanatory purposes and are not intended to limit the scope of the appended claims.

I claim:

1. A remediation packer assembly for remediating a well comprising an inlet pipe, said inlet pipe defining a plurality of radially oriented inlets, a stinger pipe, a wrap sleeve, said wrap sleeve positioned on said stinger pipe, said inlet pipe affixed to said stinger pipe, a clamp, said clamp engaging said wrap sleeve, whereby said remediation packer assembly is configured to radially remediate said well.

2. The remediation packer of claim **1** further comprising a vacuum system, said vacuum system in fluid communication with said stinger pipe.

3. The remediation packer of claim **1** further comprising a monitoring pipe, said monitoring pipe sized to frictionally engage said wrap sleeve.

4. The remediation packer of claim **1** further comprising a male coupler and a female coupler, said male coupler defining a threaded end, said female coupler defining a threaded receiver, said male coupler sized to engage said inlet pipe, said female coupler sized to engage said stinger pipe.

5. The remediation packer of claim **1** wherein said plurality of inlets define a collection zone.

6. The remediation packer assembly of claim **1** wherein said assembly is configured for injection remediation.

7. The remediation packer assembly of claim **1** wherein said assembly is configured for air sparging remediation.

8. The remediation packer of claim **1** wherein said wrap sleeve is formed from polyethylene.

9. A vacuum remediation packer assembly for collecting free product from a well comprising an inlet pipe, said inlet pipe defining a plurality of inlets, a pair of stinger pipes, each of said stinger pipes affixed at an opposing end of said inlet pipe, a vacuum system, said vacuum system in fluid communication with one of said stinger pipes, a pair of wrap sleeves, said wrap sleeves attached to different ones of said stinger pipes, said pair of wrap sleeves and said plurality of inlets adjustably defining a radial collection zone, whereby said vacuum remediation packer assembly is configured to radially remediate said well.

10. The remediation packer of claim **9** further comprising a monitoring pipe, said monitoring pipe sized to frictionally engage said wrap sleeves.

11. The remediation packer of claim **9** further comprising a first male coupler and a first female coupler, a second male coupler and a second female coupler, said male couplers each defining a threaded end, said female couplers each defining a threaded receiver, said first male and female couplers sized to engage said inlet pipe, said second male and female couplers sized to engage different ones of said stinger pipes.

12. The remediation packer of claim **9** further comprising a plurality of clamps, said clamps engaging each of said wrap sleeves.

13. The remediation packer of claim **9** wherein said wrap sleeves are formed from nitrile.

14. The remediation packer of claim **9** wherein said wrap sleeves are formed from neoprene.

15. A method of remediating a substrate comprising the steps of:

providing a remediation packer assembly including an inlet pipe defining a plurality of radially oriented inlets and attached at opposing ends to stinger pipes with one or more wrap sleeves positioned thereon, a monitoring pipe configured to receive said inlet pipe and said stinger pipes and sized to frictionally engage said wrap sleeves;

inserting the remediation packer assembly within a well; and

radially remediating the well via the plurality of inlets.

16. The method of claim **15** wherein providing a remediation packer further comprises the step of providing a plurality of screw-driven clamps, said clamps adjustably positioned on said sleeves.

17. The method of claim **16** further comprising the step of adjusting said clamps on said wrap sleeves to define a collection zone.

18. The method of claim **17** further comprising the step of positioning said collection zone in planar orientation relative to a level of free product.

19. The method of claim **15** wherein providing wrap sleeves further comprises the step of providing wrap sleeves selected from the group nitrile, neoprene, or polyethylene.

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